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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO 1132

BOMBS AND ASSOCIATED COMPONENTS

63rd Partial Report

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TESTS OF ARMING WIRES AN-M6A2, MK 1 AND MK 3

FINAL Report

Task Assignment NPG-Re3c-321-1-53

Copy No. _____

Classification RESTRICTED SECURITY INFORMATION

Tests of Arming Wires AN-M6A2, Mk 1 and Mk 3

PART A

SYNOPSIS

1. This is the final report on dynamic and tensile strength tests of AN-M6A2, Mk 1 and Mk 3 arming wires. Malfunctions of the AN-M6A2 arming wire assemblies in the Pacific Fleet were reported to have been caused by deformation of the rivet head of the swivel, allowing the head to pull through the coil of the loop. This was detected by noting that jet aircraft were returning to base with only the loop of the arming wire remaining or with the rivet head worn down and pulled almost through the coil of the loop. The purpose of the tests was to determine the breaking load of the head of the rivet on all three (3) types of arming wire under a static tensile load and the effect of a dynamic load equivalent to a five (5) pound load dropped a distance of twenty (20) inches. Also desired was a description of any apparent differences in construction of the rivet heads in the three (3) types of arming wires.

2. There was no significant difference in the rivet heads of the AN-M6A2, Mk 1 or Mk 3 wires. The rivet heads could not be made to fail in the dynamic drop test or in the tensile test. Rather, in all cases of failure, the rivet itself stretched and broke or the rivet loop or coil unwrapped. In no case was the rivet head appreciably deformed. However, the rivet head was caused to wear and pull through the coil in twenty (20) minutes by rotation with an electric drill under hand tension. Similar rivet head failure was produced with the AN-M6A2 arming wire after 90 minutes freely suspended in a 450 knot airstream. The Mk 3 arming wire freely suspended in 450 knot airstream for 90 minutes showed little evidence of wear of the rivet head. Using a Mk 51 Mod 7 rack and a water filled bomb, the AN-M6A2 arming wire was installed in the tail fuze position. This installation was subjected to the 450 knot airstream for a period of 68 minutes with no evidence of wear of the rivet head nor of wear or weakening of any other component part of the arming wire assembly.

3. It is considered highly probable that failures reported as malfunctions actually occur after the store is released. All tests performed indicate that the rivet head will not fail except when free to rotate and whip in a high speed airstream.

Tests of Arming Wires AN-M6A2, Mk 1 and Mk 3

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PART B

INTRODUCTION

1. AUTHORITY:

These tests were authorized by reference (a) as modified by reference (b) and conducted under Task Assignment NPG-Re3c-321-1-53, established by reference (c).

2. REFERENCES:

a. BUORD ltr Re3c-LME-gg JJ22 of 19 Feb 1953
b. BUORD ltr Re3c-JFF-gg F41-6 of 4 Mar 1953
c. BUORD conf ltr NP9 Re3c-BEK:mp Ser 42777 of 29 July 1953

3. BACKGROUND:

Reference (a) requested that tests be performed to determine physical characteristics of AN-M6A2 arming wires. Subject tests were urgently required in connection with reported service malfunctions. Reference (b) modified reference (a) to include comparative tests of Mk 1 and Mk 3 arming wires. Malfunctions were reported to be caused by deformation of the rivet-head of the swivel allowing the head to pull through the coil of the loop.

4. OBJECT OF TEST:

The objects of the test originally were as follows:

a. Determination of differences in construction of the rivet head of the AN-M6A2, Mk 1 and Mk 3 arming wire assemblies.

b. Determination of the load at permanent deformation of the rivet head of all three (3) types of arming wires.

c. Determination of the breaking load under a tensile pull of all three (3) types of arming wires.

d. Note the point of failure of the rivets of each type arming wire.

e. Observe deformation and note the point of failure of the rivets of each type arming wire under a dynamic test equivalent to a five (5) pound load dropped a distance of twenty (20) inches.

As the tests progressed, it became obvious that information desired could not be obtained because the rivet head could not be made to fail in the laboratory in a fashion similar to that reported by reference (b). The object of the tests then became a search for a method which would cause failure of the rivet head similar to reported malfunctions.

5. PERIOD OF TEST:

a.	Date of Project Letter	19 February 1953
b.	Date Commenced Tests	4 March 1953
c.	Date Tests Completed	27 March 1953

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEMS UNDER TEST:

a. The Mk 1 arming wire is .064 inches in diameter by 58.5 inches in length and is of low brass, phosphor bronze spring, or copper silicon alloy wire construction. The rivet is .08 inches in diameter, of soft steel wire construction, cadmium or zinc plated, with the rivet head designed to withstand a minimum load of at least 100 lbs.

b. The Mk 3 arming wire is .032 inches in diameter by 58.5 inches in length and is of spring steel wire construction, zinc or cadmium plated. The rivet specifications are the same as for the Mk 1 assembly.

c. The AN-M6A2 arming wire assembly has essentially the same specifications and dimensions as the Mk 1 assembly.

7. DESCRIPTION OF TEST EQUIPMENT:

All tensile tests were performed on Baldwin-Southwark tensile compression machine with an automatic recording attachment which produces instantaneous graphing of the load vs deflection of the item under test. The dynamic drop testing was done in accordance with enclosure (6) of reference (a). The air jet portion of the test was performed utilizing a subsonic air jet through a 6-7/8 inch diameter nozzle, produced by a 400 HP electric motor and blower.

8. PROCEDURE:

Utilizing the Baldwin tensile machine, the load required for permanent deformation and for complete failure of the rivet was determined, using twenty five (25) AN-M6A2, 25 Mk 1 and 10 Mk 3 arming wires. Using the same number of each type arming wire, performance of the rivet was obtained under a five (5) pound load dropped a distance of twenty (20) inches. Again using the same numbers of wires, a determination was made of the load required to pull off two (2) and three (3) fahnestock clips, and additionally, for the AN-M6A2 assembly, the load required to pull off two (2) and three (3) fahnestock clips under iced conditions. The iced test was performed in a cold chamber at -50°F, the wires and clips having been sprayed with water until lightly coated with ice. Measurements were made of the rivets and rivet heads of each type arming wire for comparison with specifications and with each other. These test data are tabulated in Table I, Appendix (A). Data and observations at this stage of the test indicated that desired information could not be obtained since no rivet head failures of the type reported in reference (b) had occurred. An AN-M6A2 rivet assembly was next set up with the loop secured in a vise and the arming wire secured in a hand electric drill. Rotation of the arming wire and rivet assembly caused the rivet head to wear down and pull through the coil in twenty (20) minutes. A photograph of this failure is shown in Appendix (B) Figure 8. The AN-M6A2 wire was next suspended freely in a 450 knot airstream, and a similar failure of the rivet head occurred after 90 minutes exposure. The Mk 3 wire was subjected to the same air jet test with very little evidence of wear of the rivet head after 90 minutes exposure. A photograph of these assemblies after the test is shown in Appendix (B) Figure 7. The AN-M6A2 wire was then installed in the tail fuze position on a water filled bomb using a Mk 51 Mod 7 rack, and the entire assembly subjected to the 450 knot airstream. After 68 minutes of exposure, there was no evidence of wear of the rivet head nor of wear or weakening of any other component part of the arming wire.

9. RESULTS AND DISCUSSION:

All figures tabulated in Appendix (A) are averages with loads expressed in pounds and elongations and dimensions expressed in inches.

a. In the tensile tests of the rivet in all three (3) types of arming wire, the average breaking load of the rivet was over 250 pounds and the average permanent deformation load was over 100 pounds. The rivet is designed to withstand a minimum load of 100 pounds and in this connection, it will be noted that the average permanent deformation load for the Mk 3 wire is only 101 pounds. Percentage of rivets with a permanent deformation load of less than 100 pounds is as follows: Mk 1 - 12%; Mk 3 - 40%; AN-M6A2 - 32%; these percentages cannot be considered too accurate or conclusive because in some cases, the rivet head caused spreading of the coil allowing the head to slip partially into the coil without apparent actual deformation of the rivet. These cases are included in the above percentages. The ultimate breaking load of the rivets indicates that all the rivets meet design specifications. In 50% of the cases with the Mk 3 wire, ultimate failure occurred by the rivet loop unwrapping, and in the other 50% of the Mk 3 wires tested, the rivet head pulled through the coil by spreading and unwrapping of the coil. In only 4% of the tests with the AN-M6A2 wires did the failure occur by unwrapping of the rivet loop and in no case by spreading or unwrapping of the coil. The remaining AN-M6A2 wires failed by the rivet stretching and breaking. All the Mk 1 wires failed by unwrapping of the rivet loop.

b. In the dynamic test, with a five (5) pound load dropped twenty (20) inches, there were no actual failures of the Mk 1 or AN-M6A2 wires, while 40% of the Mk 3 rivets failed by the spreading and partial unwinding of the coil, allowing the head to pull through.

c. It is considered significant that the average load required to pull off three (3) fahnestock clips under iced conditions on an AN-M6A2 wire is only 24.6 pounds. This test was performed at -50°F.

d. In the air jet test with both the AN-M6A2 wires and the Mk 3 wires, parts of the wires broke off until at the end of 45 minutes, less than 12 inches of the wire remained. No more wire broke off for the remainder of either test.

PART D

CONCLUSIONS

10. It is concluded that the strength of the Mk 1, Mk 3, and AN-M6A2 arming wires is within design specifications except for the failure by spreading and unwinding of the coil in the Mk 3 assemblies. It is further considered highly probable that reported malfunctions are not actually occurring as described in reference (b) but that the rivet head failures occur after release by the whipping action of the arming wire freely suspended in a high velocity airstream.

PART E

DISPOSITION OF MATERIAL

11. The unused arming wires are being retained in the Laboratory Services Division. Sample failures returned from Korea and samples represented by photographs in Appendix (B) are being retained. Other material tested will be disposed of as scrap unless other disposition instructions are received.

Tests of Arming Wires AN-M6A2, Mk 1 and Mk 3

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NPG REPORT NO. 1132

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Sixty-third Partial Report

on

Bombs and Associated Components

- -

Final Report

on

Tests of Arming Wires AN-M6A2, Mk 1 and Mk 3

Project No.: NPG-Re3c-321-1-53
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MAY 22 1953

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Tests of Arming Wires AN-M6A2, Mk 1 and Mk 3

TABLE I

TEST DATA

	AN-M6A2	Mk 1	Mk 3
Load at permanent deformation (in lbs.)	117.	114.	101.
Breaking load (in lbs.)	295.	251.	280.
Breaking point	a	a	a
5 lb. wt. dropped 20 in. (rivet elongation in inches)	.313 b	.324 b	.385 b
Load to pull off 2 fahnestock clips (in lbs.)	6.3	8.3	4.8
Load to pull off 3 fahnestock clips (in lbs.)	9.5	12.9	8.2
Load to pull off 2 clips (iced) (in lbs.)	17.9	c	c
Load to pull off 3 clips (iced) (in lbs.)	24.6	c	c
Dia. of rivet head (in inches)	.191	.187	.187
Dia. of rivet (in inches)	.084	.084	.084
Dia. of swivel hole (in inches)	.120	.102	.097

Notes: a. See Appendix (B) Figures 1, 2, and 3

b. See Appendix (B) Figures 4, 5, and 6

c. Iced tests were not performed

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10 April 1953
Mk 1 Arming Wire after Static Tensile Load Test.
Figure 1

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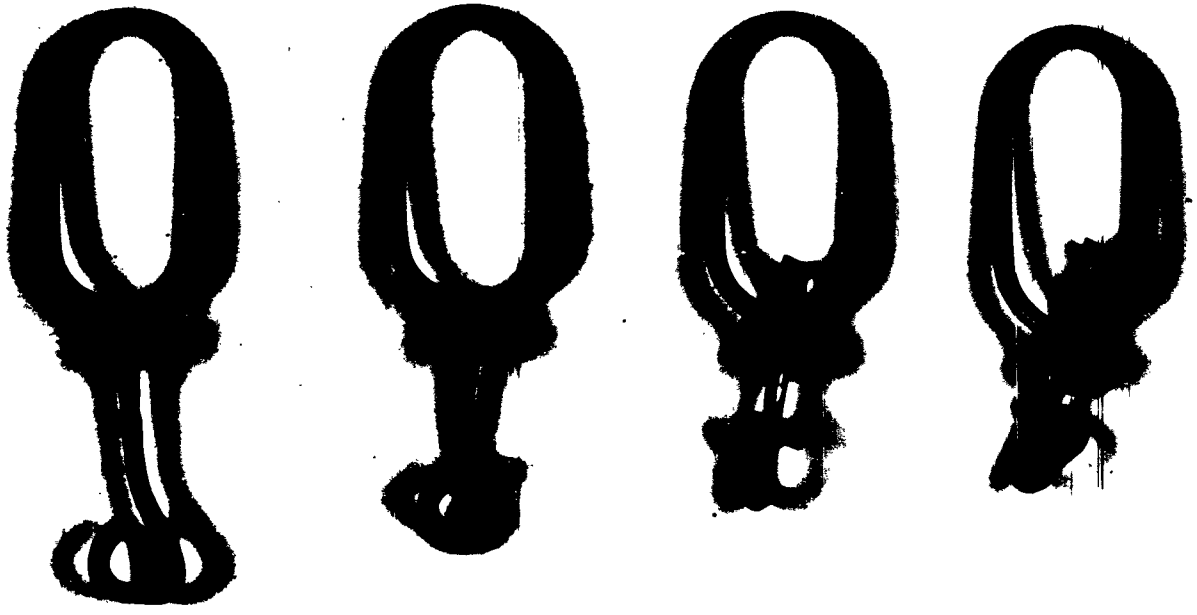

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10 April 1953

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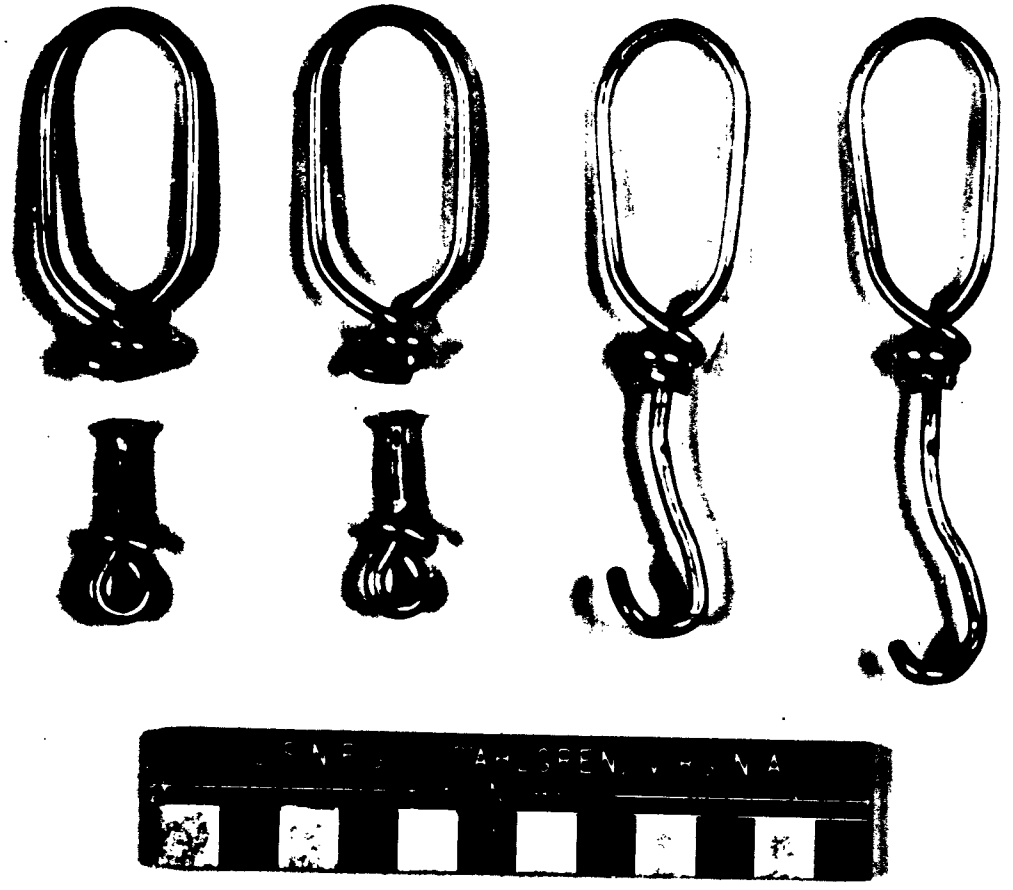
Mk 3 Arming Wire after Static Tensile Load Test.
Figure 2



10 April 1953

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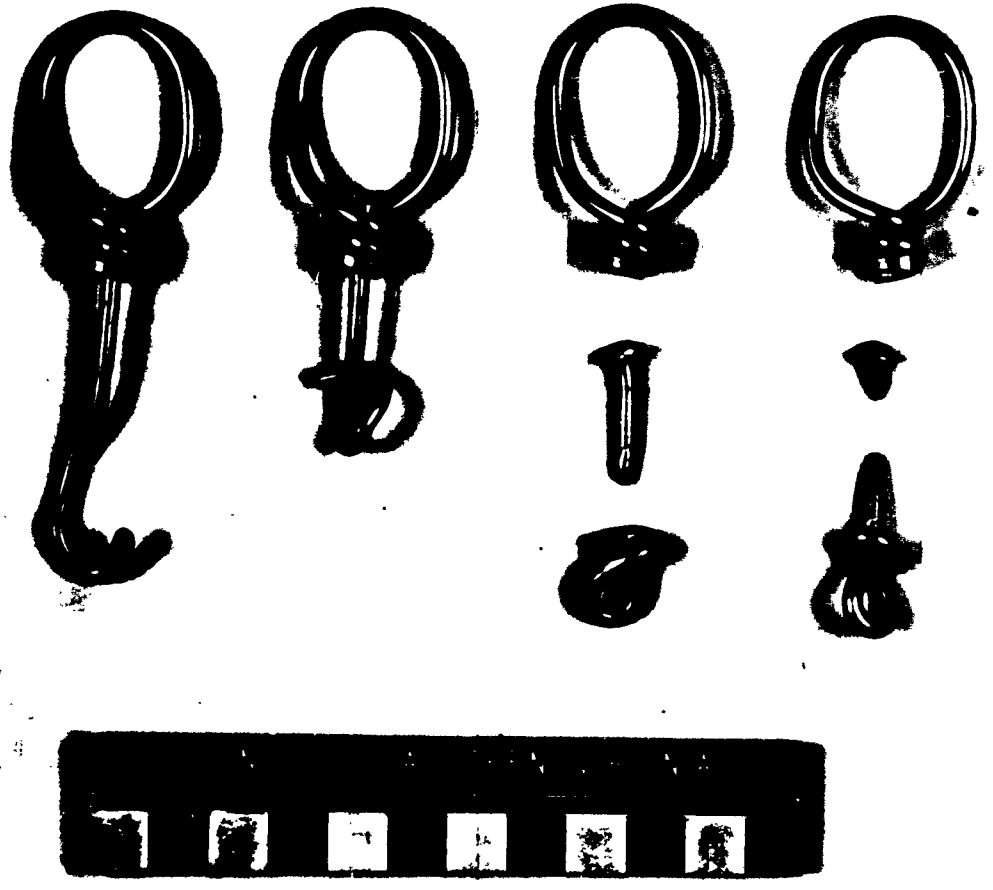
AN-M6A2 Arming Wire after Static Tensile Load Test.
Figure 3



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10 April 1953
Mk 1 Arming Wire after Dynamic Load Test.
Figure 4

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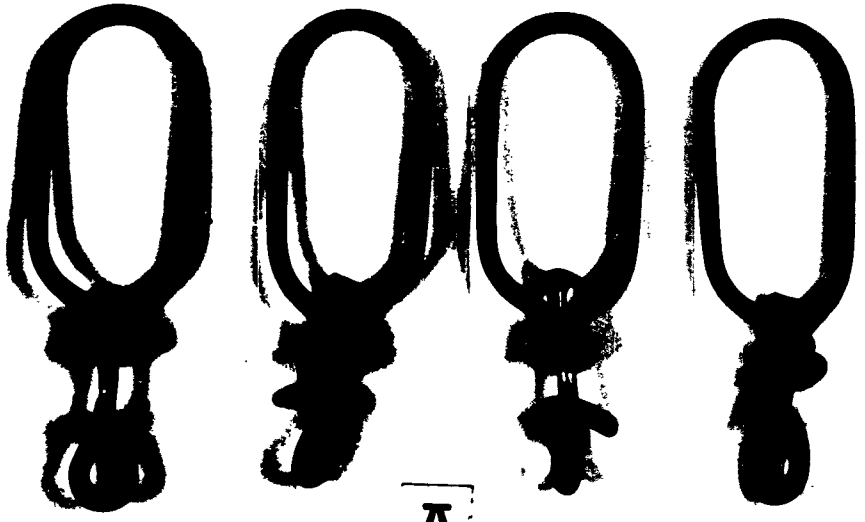

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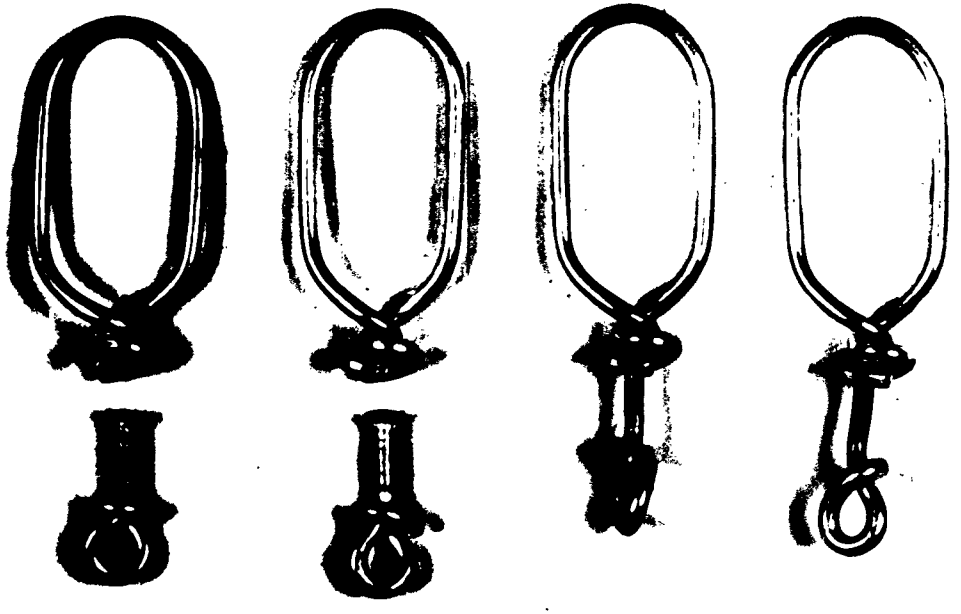
NP9-63262

10 April 1953
Mk 3 Arming Wire after Dynamic Load Test.
Figure 5

SECURITY INFORMATION



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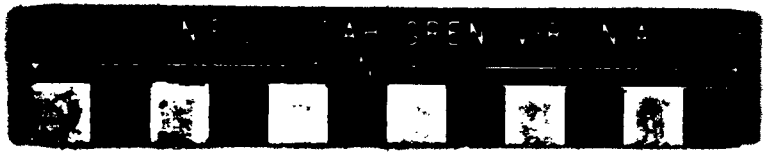
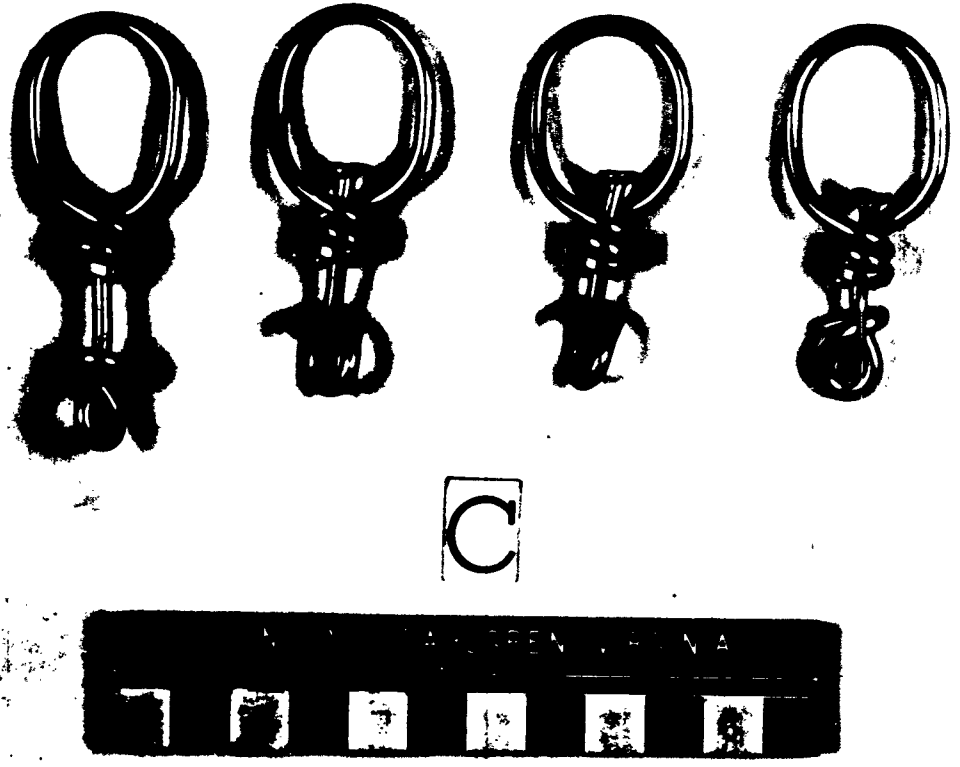
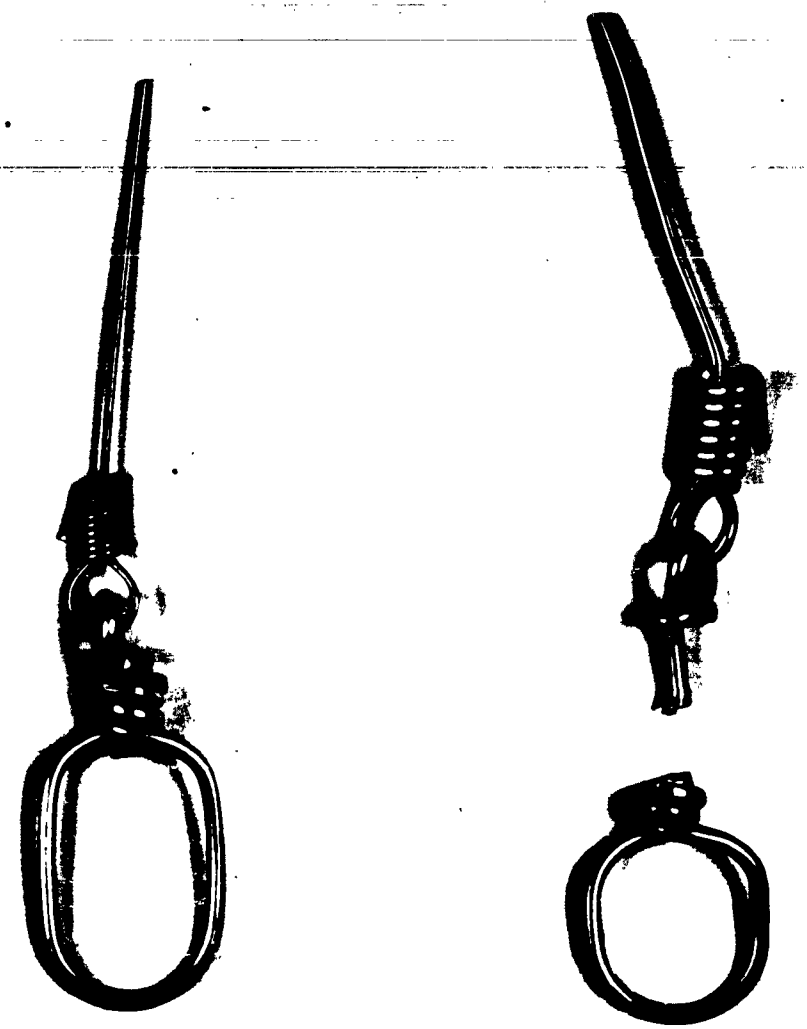


10 April 1953
AN-M6A2 Arming Wire after Dynamic Load Test.
Figure 6





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Mk 3 and AN-M6A2 Arming Wires after Air Jet Test.
Figure 7

-63265 10 April 1953 RESTRICTED
-26A2 Arming Wire after Portable Hand Drill Test. SECURITY INFORMATI
Figure 8